

I. *A Letter from Mr Anthony van Leeuwenhoek, F.R.S. Containing his Observations upon the Seminal Vessels, Muscular Fibres, and Blood of Whales.*

*Delft in Holland, March 1. 1712.*

I Have formerly affirm'd, that the *Animalcula in Semina Masculino* of a Horse, and those of a Dog, are of one and the same bigness; at least, that they appear'd so to me thro' the Microscope.

Since which time I have been very desirous to observe the *Semen Masculinum* of a Whale, in order to discover, if it were possible, whether the *Animalcula* in those great Creatures did not proportionably exceed such as I have discover'd in smaller Creatures.

Having therefore made an Acquaintance with one *Isaac van Krimpen*, who had for many Years been concern'd in the Whale Fishery, as Commander of a *Greenland Ship*; and he being an observing Man, I intreated him that he would give me a piece of the *Penis* of a Whale, viz. of the thickest part of it, where it was joyn'd to the Body, in hopes that I might still discover some of the *Animalcula* that were in the *Vasa deferentia*.

The Captain accordingly help'd me to such a piece; but in the hanging it up, and stretching and drying it, I believe the *Semen Masculinum* was run out of it, because he had hung up and dry'd that Member, in order to get Train Oyl out of it. Having open'd the *Vas seminale* as well as I could, for it was very much dry'd up, and scraped off a little of the Matter that was in it with

with a small Knife, I mix'd it with a little Rain Water, in order to separate the Parts from one another: Whereupon I observ'd in the said Matter a great number of long four-sided Particles, most of them having 4 Right Angles, but of different sizes, and many of 'em were three times as long as they were broad; but I saw none of 'em so broad as the Diameter of the Hair of a Man's Head, and the smallest was a hundred times less, in some few of which I could perceive no thickness.

All the said Particles, or little Figures, were as clear as Crystal, so that I concluded that they were fix'd Salts; and the rather, because they were so hard, that they were not dissolv'd in the Water. And when this Matter, which I had scrap'd out of the Vessels of the Whales *Penis*, had lain a little longer in the Water, I discover'd Salt Particles; the two longest sides of which run parallel to each other, but the two shortest Sides oblique; so that one end of 'em had a sharp, and the other an obtuse Angle: And tho' the Salt Particles had lain at least a Week in Water that was frozen, and the same Water afterwards dissolv'd, yet I saw the Salts floating in it.

As many Observations as I made, I could not discover the least Particle that bore any resemblance to the *Animalcula in Semine Masculino*.

The said Captain having inform'd me, that the Testicles of a Whale are as big as a Firkin of Butter that weighs about a hundred Weight, I intreated him the next Whale he took, to cut off the *Vasa Semen deferentia* as near the Testicles as he could, and to lay them a drying upon a Plank, or to let the Surgeon do it, whom they have always on board, and who is fittest for such a work; for by that means I hop'd to discover the *Animalcula* therein: But as yet my Request has not been comply'd with.

The same Person told me, that he had never found but one young Whale in the Belly of the Mother, and that was in a Whale which he had taken; the Body of which bursting open some Days afterwards, there came out a young Whale that was Fifteen Foot long; but he could not tell, whether they were Feet consisting of Eleven, or of Twelve Inches.

About two Years ago there came a Stranger to me, who had two *Penis's* of the Whale Fish; and I took the liberty to ask him of what use those Members were; but he made me no other Answer, than that they were used in Physick. Soon after came the aforefaid Captain to me, and presented me with some Slices of a Whale's *Penis*; adding, that a little of it grated, or cut into small Pieces, and boil'd in Milk or Beer, was very good against the *Bloody Flux*, and that a Neighbour of his, who had been ill of that Distemper a whole Year, was cur'd by the same Medicine.

The said Captain told me also, that the Female of a Whale (on the side of the *Uterus*, but a little nearer its Tail) has two Nipples, or Teats, which yield Milk, and that he had drank thereof; and he shew'd me the Teats, the Diameter of one of which was no more than an Inch and a half, and it was two Inches long, but it was dry'd hard.

I intreated the Captain when he return'd again to the Whale-fishing, to bring me some of the Flesh of a Whale that had been dry'd in the Air; because that which had been provided for me before, stunk very much, and was almost rotted, and so was not fit for my purpose.

He brought me two pieces of hard dry'd Flesh, of the length of a Span, and of the thickness of ones largest Finger. They were as black as Pitch; but, as he says, when the Flesh was cut off, it was red. From the blackness of it I concluded, that the Blood was of a deep or dark Red; which the Captain also confirm'd; adding, that where the Blood fell, it left a Stain.

I cut through the Flesh both cross and length-ways, in order to discover the thickness of its Particles; and after I had cut thin Scales a-cross, they appear'd of a bright red Colour; but when I cut them thicker, they were of a dark Red; and when very thick, they were blackish. In this Operation I observ'd, that the small Fleshy Muscles were surrounded with very thin Fibrous Particles, that look'd like little Membranes torn to pieces: And upon several Parts of these little Membranes, there lay Fat, which, when there is a quantity of it together, they call the Train; and these Train Particles lay pressed together in the same manner as I have formerly described those of an Oxe; nor were they bigger than the Particles of the Fat of an Oxe; and many of these Particles were like melted Fat; insomuch, that when I squeez'd the Flesh, the Fat came out at the end of it.

I laid a small part of this Flesh, after that I had cut it into little pieces, in Water; and I observ'd that the Flesh was thinner when it was dry, than when it was soak'd through: and in comparing the Flesh of a Whale with the Flesh of an Oxe, I judg'd that the Particles of the former were finer than those of the latter.

Now, in order to demonstrate the fineness or slenderness of the Parts of the Flesh, length-ways, of so great a Creature as the Whale is (for this was above 50 Foot long) I placed one of the Hairs of my Beard by one of the Flesh Particles of the Whale, and I judg'd that the said Hair was at least Nine times thicker than one of those which I may call a little Flesh Muscle, it being again compos'd of other long Particles or Fibres.

I could not ascribe either a round or Sexangular Figure to these little Flesh Muscles of the Whale, because they lay so compress'd in one another, that they appear'd in several Shapes, but most of 'em were incli-

ning to a Sexangular: And when I view'd them more curiously at their ends, I observ'd for the most part that one Flesh Particle was wrapt up in six others, but not regularly, for one took up more place than another; infomuch, that sometimes the outward Flesh Particle did not touch the inward but in one point.

When I cut the afore-mention'd long slender Flesh Particles, either across or obliquely with a sharp Knife, I could see therein a vast number of exceeding small Particles, of which one of those Flesh Particles did consist, and they were also cut across: And through the Microscope it appear'd to me just as if one should see with the naked Eye small Grains of Sand lying upon them; and I also could discover the ends of them. In these my Observations there appear'd to me a great many Flesh Particles, surrounded with little Figures like Rings, and very close to one another, just as if you should take a common Iron Wire, and twist it about with another very fine one: And such circular Flesh Particles have I formerly observ'd in the Muscular part of the Paw or Foot of an Gnat; but the Rings were closer to one another in the Flesh Particles of a Whale, than in those of a Gnat; and if I remember right, the Flesh Particles (or Fibres) of a Gnat, were as thick as those of a Whale. How wonderful are such Contextures!

From the said Observations one may more firmly conclude, that when the Muscles are stretch'd out, the Flesh Particles have no Wrinkles; and that when they lye in their natural Position, then the Flesh Particles have Wrinkles

I was above measure astonish'd at these my Observations, having always imagin'd, that the Flesh Particles of very great Creatures, such as the Whale is, should have been compos'd of greater Parts, in proportion, than others.

In these Discoveries it was very remarkable, that each of the before-mention'd long Flesh Particles appear'd to me as if they were wrapt about with a little thin Membrane, which I observ'd in a thousand several Places; and the more easily, because as the Flesh Particles grew dryer, these fine Skins or Membranes were separated from them.

The afore-mention'd Captain acquainted me, that the Whale has three distinct Skins; the uppermost of which is very thin, and the next to that is as soft as Velvet; but the third and undermost is a thick Skin, which we call the *Sward*, and is like the Skin of a Hog. Soon after he gave me a little piece of the first Skin, which he said was easily separated from the second; it was no thicker than a Leaf of Writing Paper. Having view'd that Skin thro' a Microscope, I judg'd it to be compos'd of such flattish Particles as I can call by no other Name than little Scales, and which were no bigger than the little Scales of which our own outmost Skin is compos'd: But whereas the Scales of our Skin are very easily separated, and especially the uppermost Scales, which are shed or cast often, the little Scales of the Skin of the Whale are firmly united together.

When I came to consider the aforesaid Skin, with regard to its thickness, I judg'd it to be compos'd of not fewer than four Skins, lying upon each other: But when I view'd the same more nicely, I discover'd, that there were at least twenty Skins upon one another; all which were compos'd of little Scales, and of exceeding small Particles that lay scatter'd under those Scales; but as carefully as I examin'd the said Skin, I could not discover in it the least Fibres or Vessels.

From these Observations I concluded, that the aforesaid uppermost Skin was separated of itself from the rest; which the Captain also confirm'd; adding moreover, that he gave but one cut or slit in the uppermost

Skin, and then twisting it about a round Stick of Wood, it came very easily off from the second Skin.

In several of my Observations I did discover, that there were a great many Salt Particles, most of them of the Colour of Ashes, shut up in the outmost Skin ; but I separated them from it by Rain Water. These Salt Particles were twice as long as they were thick, having each of them four Right Angles ; they lay coagulated in a very clear thin Liquor, which did not evaporate or melt away in rainy Weather : From whence I concluded, that they were nothing but common Sea Salt.

Moreover, I observ'd a great number of very small Salt Particles, that were about as long as the former, but exceeding slender.

I got also a piece of the second Skin of a Whale, about as broad as my Hand, which was as black as Pitch, and had four or five Protuberances or Bumps on it, that were about as big as the third part of a Pea ; and which, I was told, were occasion'd by the biting of the Lice, of which there were great Numbers upon the Whales Body.

This Skin was dry'd hard, and was almost half an Inch thick ; but it was not strong, because there were no Vessels or Sinewy Fibres running through each other, as in the Skins of Beasts and our common Fish ; only there were some small Fibres that joyn'd it a little to the Skin that lay under, and which pass'd, as it were, in a Right Line to the uppermost Superficies of the Skin. These Strings, or Fibres, were so close to one another, that there was not above the breadth of two or three Hairs between them ; they were transparent or whitish, and in one of them I could discover a Blood Vessel.

The undermost, or third Skin, was whitish, and so strong withal, that I concluded, that in case the Harping Iron was struck so deep into the Whale, that the Beard or Hooks thereof did penetrate into the afore-said

said white or third Skin, it would keep its hold ; but if it went no farther than into the black Skin, it would easily be torn out.

I have done my utmost Endeavour to discover the Parts of the aforesaid black Skin, but could not do it to my Satisfaction ; for when I cut it very thin, I judg'd it to be full of a great many small Pores or Openings, and that upon this account it was not so heavy as I supposed a close solid Body ought to be ; and I saw in it little black spots standing so near one another, that you could hardly thrust a Hair between ; and these Spots were the cause of its being lighter. So have I observ'd in the Skins of Beasts, in many places, between the Parts of which the Skin is composed, a great number of little Globules, which I found to be Fat ; but in the aforesaid Skin I could discover no Fat ; which appear'd very strange to me, because it is well known, that Whales have 10, 14, 15, or more Inches thickness of Fat (which they call Bacon) under the third Skin.

Moreover I observ'd, that the black Skin was clammy, or Glutinous, when it was wet ; from whence I concluded, that People might draw a very good Glue from it.

From the black Skin and black Blood of a Whale, I turn'd my Thoughts to the black Blood of a Salmon ; and supposed, that the redness of the Flesh of that Creature, was alone occasion'd by the blackness of its Blood ; and that in like manner the blackness of the Flesh of Whales proceeded from the same Cause.

From hence I was considering, whether the blackness of the Men upon the Coast of *Guinea*, might not also proceed from their black Blood ; and whether also their Flesh might not be blacker than that of white Men, and that the blackness of their Skin alone depended upon



upon their black Blood ; which deserves to be consider'd.

Now since we see that the Particles of Flesh, Fat, and little Membranes of the Whale, are no bigger than those of an Oxe, and that the bigness of Creatures does alone depend on the Number or Quantity of their Parts, we may easily conceive why the *Animalcula in Semine Masculino* of a Whale, are not bigger than those in our common four-footed Creatures.

As for what belongs to the Fat of a Whale, which we call Bacon, and out of which we boil the Train-Oyl, I found the Parts as Fluid as those of the Fat of our River Fish ; for I have often view'd with a Microscope the Fat of an Ell, and took a great deal of Pleasure in observing the Globular Particles, which lay, as it were, compress'd in one another ; but my Pleasure was very Transitory, by reason of the Fluidity of those Parts.

Thus You have what I thought proper to communicate to you, and remain with great Respect,

*Your Humble Servant,*

Anthony van Leeuwenhoek